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Physics 30X
August, 1968

HIGH SCHOOL AND UNIVERSITY MATRICULATION

EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1968

AUGUST

PHYSICS 30X

Time 2 hours.

Total Possible Mark -- 146

Questions 1 to 52 are multiple choice questions and are valued at two marks each.

Your score in this section is the number of correct answers you give. If a question seems to be too difficult, make the most careful guess you can, rather than waste time puzzling over it.

Note -- Mathematical tables will be supplied by the presiding examiner. Slide rules may be used.

Use the following constants where they are required:

$g = 10\ \text{m/sec}^2$

1 coulomb = 6.24×10^{18} elem. ch.

1 volt = 1.6×10^{-19} joules/elem. ch.

Mass of electron = 9.0×10^{-31} kg

Constant in Coulombs Law = $9.0 \times 10^{9}\ \dfrac{\text{newton - m}^2}{\text{coulomb}^2}$

1 cal = 4.2 joules

Write your name and school in the space provided on the separate answer sheet but do not write your name on this booklet.

Finished work in this booklet must be done in pencil or blue or black ink (pen or ballpoint).

DO NOT FOLD EITHER THE ANSWER SHEET OR THE TEST BOOKLET.

Place your answer sheet BEHIND the test booklet and INSERT BOTH IN THE SAME ANSWER ENVELOPE in such a way that the UPPER LEFT-HAND CORNER OF THE BOOKLET (Candidate's Number) shows through the SLASHED CORNER of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

MACHINE SCORE
BOOKLET SCORE
TOTAL

(For the use of Sub-Examiners only)

0X

HIST

Questions 1-52 inclusive are to be machine scored. You are to record your answer on the separate answer sheet which will be provided. Each question has four suggested answers. Select the BEST answer and record it on the separate ANSWER SHEET, as shown in the example below.

EXAMPLE	ANSWERS	ANSWER SHEET
A body moves at the rate of 4.0 m/sec. How far will it travel in 10 sec?	A. 20 m B. 40 m C. 60 m D. 80 m	A B C D E ☐ ■ ☐ ☐ ☐ DISREGARD COLUMN "E"

You are to use an ORDINARY HB PENCIL to mark your answers on the ANSWER SHEET. Make certain your answer marks are heavy and black and that they do not extend beyond the guide lines. If you change your mind about an answer, be sure to erase your first mark completely. There should be only one answer marked for each question. Be sure there are no stray pencil marks on your answer sheet.

1. A car travels a measured distance of 20.02 mi in an observed time of 15 min. Its average velocity for the trip is correctly stated as

1. A. 80.08 mi/hr
B. 80.1 mi/hr
C. 80 mi/hr
D. 8 X 10 mi/hr

2. In an investigation, pictures of the vibrating wings of an insect were taken at the rate of 4800 frames/sec and shown at the rate of 24 frames/sec. If it takes 2.0 sec to observe one complete vibration of the wings by viewing the film, what was the rate of vibration of the insect wings in real life?

2. A. 200 vibrations/sec
B. 400 vibrations/sec
C. 2400 vibrations/sec
D. 100 vibrations/sec

FOR ROUGH WORK
(No marks given for work in this space)

3. The height and weight of a growing organism were measured simultaneously at several times during its growth and recorded in the table below. When the organism is 5.0 cm high, its weight, determined by extrapolation, is

3. A. 80 g
B. 96 g
C. 125 g
D. 512 g

Measurement number	Height in centimeters	Weight in grams
1	1.0	1.0
2	2.0	8.0
3	4.0	64

FOR ROUGH WORK
(No marks given for work in this space)

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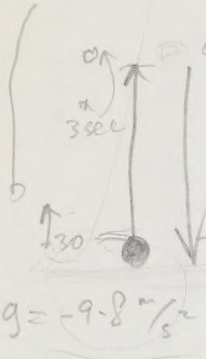
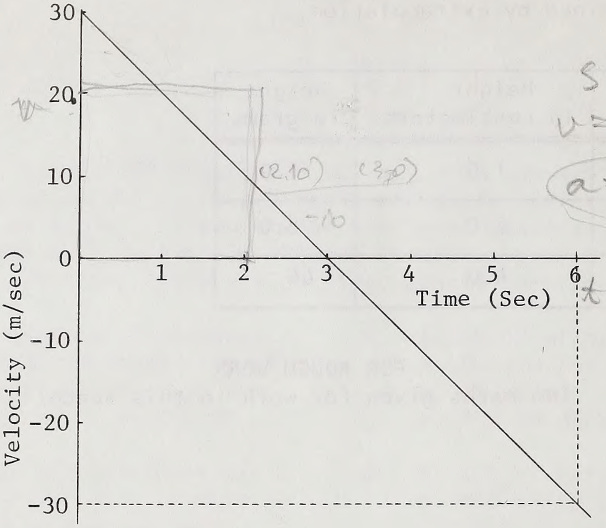
(OVER)

Questions 4 and 5 relate to the following information.

The graph below shows the motion of a body in a vertical direction. Initially it is rising at the rate of 30 m/sec.





S

$v = \frac{ds}{dt}$

$a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$

m

4. During the first two seconds it travels

4.
A. 30 m
B. 40 m
C. 60 m
D. 80 m

5. When 3.0 sec have passed, its upward acceleration is

5.
A. 0 m/sec^2
B. 0.10 m/sec^2
C. 10. m/sec^2
D. -10. m/sec^2

FOR ROUGH WORK
(No marks given for work in this space)

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Questions 6 - 9 relate to the following information.

Two airplanes, A and B leave the same airport at the same time. Airplane A flies in a straight line, with a speed of 100 mph relative to the ground, to a point 200 mi due south of the starting point. Airplane B maintains a speed of 160 mph relative to the air while it flies in a straight line to a point due east of the starting point. Over the whole region a steady wind blows from the south at 80 mph.

6. Airplane B has a groundspeed of

6. A. 80 mi/hr
B. 139 mi/hr
C. 179 mi/hr
D. 240 mi/hr

7. Airplane A will arrive at its destination

7. A. about 2 hr after starting
B. 1.1 hr after starting
C. about 10 hr after starting
D. none of these

8. The difference between the headings of the two airplanes is

8. A. 30°
B. 60°
C. 90°
D. 120°

9. The two airplanes, when in flight, move apart with a speed of

9. A. 171 mi/hr
B. 189 mi/hr
C. 240 mi/hr
D. 260 mi/hr

FOR ROUGH WORK
(No marks given for work in this space)

10. Body A of mass M-kg is acted upon by a force 4F newtons. Body B of mass 2M-kg is acted upon by a force F newtons, then

10. A. Body A will have twice the acceleration of body B
B. Body B will have twice the acceleration of body A
C. Body A will have the same acceleration as body B
D. Body A will have eight times the acceleration of body B

$F = ma$

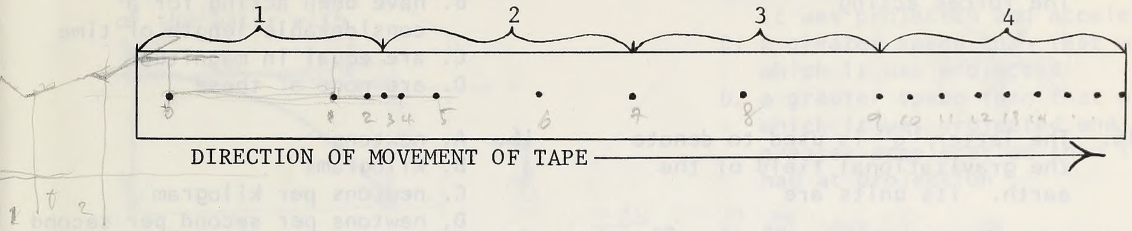
$a = \frac{F}{m}$

$= \frac{4F}{m}$ $\underline{2m}$

$= 4 , \frac{1}{2}$

FOR ROUGH WORK
(No marks given for work in this space)

Questions 11 to 14 relate to the following diagram and information.



The diagram represents a length of paper tape that has been pulled through a vibrating timer. The tape has been divided into sections 1, 2, 3 and 4, of equal length, for convenience.

11. The maximum speed of the tape occurred in

11. A. Section 1
B. Section 2
[✓ C. Section 3]
D. Section 4

12. The maximum acceleration of the tape occurred in

12. A. Section 1
[✓ B. Section 2]
C. Section 3
D. Section 4

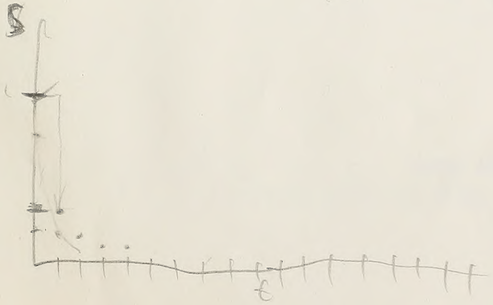
13. The speed of the tape was uniform in

13. A. Section 1
B. Section 2
C. Section 3
[✓ D. Section 4]

14. The section that moved through the timer with the highest average speed was

14. A. Section 1
B. Section 2
[✓ C. Section 3]
D. Section 4

FOR ROUGH WORK
(No marks given for work in this space)



15. A body, acted upon by four forces, moves at constant speed. The forces acting

- A. are small compared with the mass of the body
- B. have been acting for a considerable length of time
- C. are equal in magnitude
- D. are none of these

16. The letter "g" is used to denote the gravitational field of the earth. Its units are

$F = ma$ $kg \cdot \frac{m}{s^2}$ $\frac{kg\,m}{s^2}$. $\frac{m}{s^2}$

- A. newtons
- B. kilograms
- C. newtons per kilogram
- D. newtons per second per second

17. An object falling near the surface of the earth reaches its terminal velocity when air resistance equals the

- A. mass of the body
- B. acceleration of the body
- C. momentum of the body
- D. weight of the body

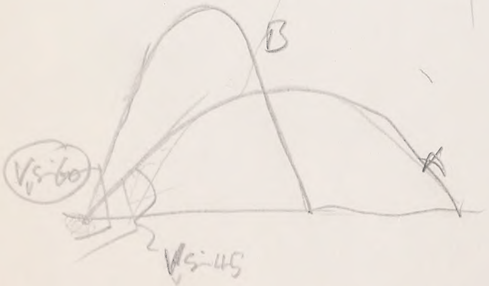
18. Two balls are thrown into the air from the same location. Ball A is thrown at 45° above the horizontal while ball B is thrown at 60° above the horizontal. If they are both in the air for 2.0 sec before returning to earth then

- A. ball A had a greater initial speed than ball B
- B. ball B had a greater initial speed than ball A
- C. ball A rose vertically higher than ball B
- D. ball B rose vertically higher than ball A

FOR ROUGH WORK
(No marks given for work in this space)

$F = ma$

$a = \frac{F}{m} = \frac{N}{kg} = m/s^2$



19. A stone is thrown horizontally out to sea from the top of a cliff. It strikes the surface of the water with

19.
- A. the same speed as that with which it was projected
- B. the same speed as that with which it was projected and accelerating
- C. a greater speed than that with which it was projected
- D. a greater speed than that with which it was projected and a greater acceleration than it had at projection

20. A 1.0 kg mass swung on the end of a rope is just maintained in a vertical circular path if the speed of the mass at the top of the swing is 10 m/sec. What would the speed have to be if a mass of 4.0 kg were used with a rope of the same length?

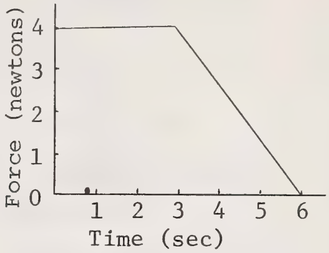
20.
- A. 20 m/sec
- B. 40 m/sec
- C. 2.5 m/sec
- D. 10 m/sec

21. Near the surface of a certain planet the acceleration of a falling body is 5.0 m/sec^2. If this planet has the same mass as the earth then its radius is

21.
- A. 4 times that of the earth
- B. 2 times that of the earth
- C. $\sqrt{2}$ times that of the earth
- D. 0.5 times that of the earth

FOR ROUGH WORK
(No marks given for work in this space)

Questions 22 to 24 refer to the following diagram and information.



The force acting on a 3.0 kg body varies with time as shown in the sketch graph

22. What impulse is supplied to the body during the 6.0 sec?

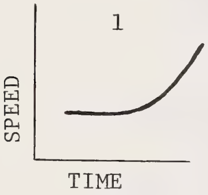
22. A. 18 newtons
B. 18 kg-m/sec
C. 18 newton/sec
D. none of these

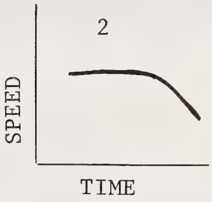
23. What is the change in the speed of the body during the 6.0 sec?

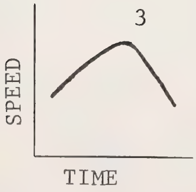
23. A. 6.0 m/sec
B. 18.0 m/sec
C. zero
D. none of these

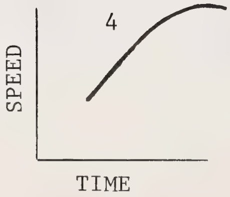
24. Which of the following graphs best represents the nature of the body's change of speed during the 6.0 sec?

24. A. Sketch 1
B. Sketch 2
C. Sketch 3
D. Sketch 4









FOR ROUGH WORK
(No marks given for work in this space)

25. A reading of 12 newton-sec/kg is a measure of

25.
A. speed
B. mass
C. acceleration
D. momentum

26. An inelastic collision is one in which

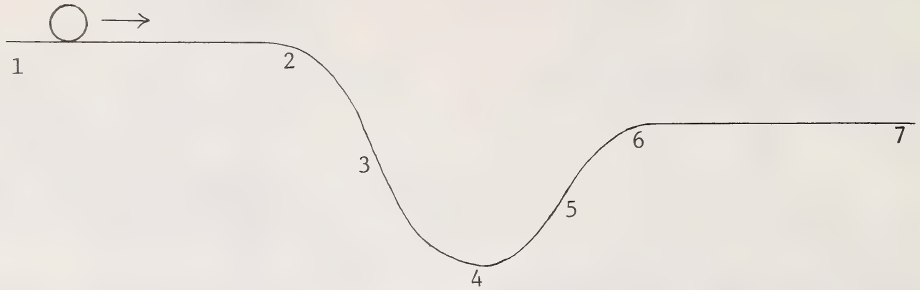
26.
A. total energy is not conserved
B. no energy is transferred from one body to another
C. the initial and final kinetic energies are not equal
D. total momentum is not conserved

27. If the net force acting on a body is NOT zero and no work is being done, then the body could be moving

27.
A. down an incline at uniform speed
B. up an incline at uniform speed
C. in a circular path
D. in a circular path without acceleration

FOR ROUGH WORK
(No marks given for work in this space)

Questions 28 to 31 relate to the following diagram and information.



A ball rolls on a frictionless surface 1-2-3-4-5-6-7. It has a uniform speed on the horizontal section 1-2.

28. The ball will have its maximum kinetic energy at position

28.
A. 2
B. 4
C. 6
D. 7

29. The kinetic energy of the ball will be greater at

29.
A. position 7 than at position 1
B. position 3 than at position 5
C. position 2 than at position 6
D. none of these

30. The ball will have a momentum

30.
A. constant throughout
B. greater at position 7 than at position 1
C. greater at position 3 than at position 5
D. greater at position 2 than at position 6

31. The total energy of the ball will be

31.
A. constant throughout
B. greatest at position 1
C. greatest at position 4
D. greatest at position 7

FOR ROUGH WORK
(No marks given for work in this space)

32. Bodies of equal mass projected vertically upwards from the surface of the earth reach heights that are

32. A. directly proportional to their initial velocities
B. directly proportional to the square roots of their initial velocities
C. directly proportional to the square of their initial velocities
D. independent of their initial velocities

33. A rock of mass 1.0×10^3 kg situated at the top of a mountain 3.0×10^3 m high has a gravitational potential energy with respect to sea level of

33. A. 3.0×10^7 joules
B. 3.0×10^6 joules
C. 30 joules
D. 0.3 joules

34. A linear spring of natural length 50 cm has a force extension ratio of 40 newtons/m. If it hangs vertically what mass hung on its lower end will cause a 20% increase in length?

34. A. 400 kg
B. 40 kg
C. 4.0 kg
D. 0.4 kg

35. If the velocity of each molecule of an enclosed mass of gas is reduced to one-quarter of its original value then the pressure of the gas would become

35. A. one-half its original value
B. one-quarter its original value
C. one-sixteenth its original value
D. sixteen times its original value

FOR ROUGH WORK
(No marks given for work in this space)

36. The temperature of an enclosed mass of gas is raised from 25° C to 125° C. If the original pressure was 9.0×10^3 newtons/m^2 then the final pressure would be approximately

36. A. 1.8×10^3 newtons/m^2
B. 1.2×10^4 newtons/m^2
C. 3.6×10^4 newtons/m^2
D. 4.5×10^4 newtons/m^2

37. The amount of heat required to raise 1.0 gm of water by 1.0 C° is

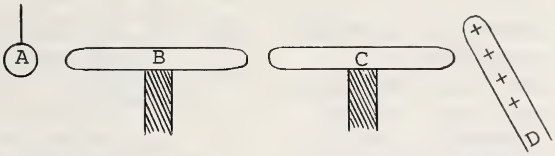
37. A. 4.2 joules/cal
B. 4.2 cal
C. 1.0 joule
D. 1.0 cal

38. The temperature of a body measures the average

38. A. energy of center of mass motion of the molecules
B. energy of the molecules
C. internal energy
D. kinetic and potential energy of the molecules

FOR ROUGH WORK
(No marks given for work in this space)

Questions 39 and 40 relate to the following information.



The diagram above shows an arrangement of a metal coated ball A suspended on an insulating thread, two identical neutral rods B and C mounted on insulating stands, and a positively charged rod D.

39. If A is strongly attracted to B when the bodies are arranged as above, but little or no attraction is apparent when C is removed then there is evidence that

39. A. C is an electrical conductor
B. B is an insulator
C. A is charged positively
D. none of these is true

40. If a wire is connected from B to C in the arrangement above

40. A. electrons will flow from C to B
B. A will be repelled
C. A will no longer be influenced
D. A will continue to be attracted

FOR ROUGH WORK
(No marks given for work in this space)

41. An electroscope can be shielded from the effect of nearby charges by

41. A. connecting a battery to it
B. enclosing it in a metal container
C. enclosing it in a glass container
D. producing a vacuum around it

42. A tiny charged sphere is suspended one centimeter away fron an oppositely charged flat conducting plate which is one meter square. If the sphere is moved closer to the plate the force of electrical attraction upon it

42. A. varies inversely as the square of the distance from the plate
B. varies inversely as the distance from the plate
C. varies as the square of the distance from the plate
D. does not change appreciably

43. In the micro-microbalance used in the Millikan experiment the magnitude of the electrical driving force acting on a tiny sphere between the charged plates is INDEPENDENT of the

43. A. separation of the plates
B. amount of charge on the sphere
C. kind of charge on the sphere
D. voltage across the balance plates

44. Two equally charged particles, X and Y, start from rest at the same time and move due to the force exerted by the same uniform electrical field. If, after a certain very short length of time has passed, both particles are still accelerating uniformly but particle X has gone 3 times as far as particle Y, then

44. A. particle X has the same kinetic energy as particle Y
B. particle X has $\sqrt{3}$ times as much kinetic energy as particle Y
C. particle X has 3 times as much kinetic energy as particle Y
D. particle X has 9 times as much kinetic energy as particle Y

FOR ROUGH WORK
(No marks given for work in this space)

45. Two flat parallel plates are 2.00×10^{-2} meters apart and have a potential difference of 300 volts. The amount of energy transferred to a number of particles carrying a total of 5.0×10^{-10} coulombs of charge as they are allowed to move from one plate to the other is

45. A. 6.0 joules
B. 300 joules
C. 3.0×10^{-9} joules
D. 1.5×10^{-7} joules

46. When an electron is moved from a position near another electron to a position twice as far away from it, the electrical potential energy of the two particles is

46. A. changed to half its original value
B. doubled
C. increased to 4 times its original value
D. reduced to a quarter of its original value

47. The ends of a uniform high resistance wire 10 meters long are connected to the terminals of a 12 volt battery. The potential difference between the midpoint of the wire and a point 1.0 meter from one end of it is

47. A. 12 volts
B. 4.8 volts
C. 1.2 joules
D. 120 joules

48. In an experiment using a "current balance" to determine the strength of a magnetic field produced by an electric current in a coil, a student doubled both the current in the coil and the current through the loop of the balance. These increases together will

48. A. not change the force on the balance
B. double the force on the balance
C. multiply the force on the balance by four
D. multiply the force on the balance by sixteen

FOR ROUGH WORK
(No marks given for work in this space)

49. In an experiment using a magnetic field to measure the masses of charged particles travelling across it, the experimenter wishes to decrease the radius of curvature of the paths of the particles. He can do this by

49. A. increasing the strength of the magnetic field
B. using particles with a greater mass but the same charge
C. using particles with a smaller charge and the same mass
D. increasing the velocity of the particles

50. To determine the amount of force exerted on a straight current carrying wire due to a magnetic field it passes through, one needs to know the amperage of the current, the length of the wire in the field the strength of the magnetic field as well as the

50. A. voltage which causes the current
B. resistance of the current carrying wire
C. speed of the electrons in the wir
D. direction of the current with respect to the direction of the magnetic field

51. When a loop of wire is rotated in a magnetic field the EMF generated it is INDEPENDENT of the

51. A. area enclosed by the loop
B. resistance of the loop
C. strength of the magnetic field
D. rate at which the loop is rotated

52. Electric charges accelerating at the greatest rate cause

52. A. the weakest coulomb field
B. the strongest coulomb field
C. electromagnetic radiation of shortest wave length
D. electromagnetic radiation of longest wave length

FOR ROUGH WORK
(No marks given for work in this space)

In answering the following problems, show your solutions in logical steps. When diagrams are drawn to scale, the scale should be clearly indicated.

5 53. A train accelerates uniformly from a speed of 5.0 m/sec at point A to 25 m/sec at point B. If points A and B are 1.2 km apart on a straight piece of road, how fast is the train going when it is half way between them.

FOR ROUGH WORK
(No marks given for work in this space)

Values

6 54. A body is projected at an angle of 45° above level ground with an initial velocity of 50 m/sec. How far will it travel in a horizontal direction?

3 55. By driving around a circular track at 40 mph a car driver experiences a centripetal force of 25 newtons. He speeds up and the force becomes 100 newtons. What is his new speed?

FOR ROUGH WORK
(No marks given for work in this space)

Values

7 56. A 50 gm steel ball moving at 4.0 m/sec along a horizontal surface strikes a 30 gm steel ball initially at rest. After the collision the 50 gm ball is moving in a line 30° off its original path at 2.0 m/sec. Determine the velocity of the 30 gm ball after the collision.

(OVER)

Values

3 57. From what height would a 10 kg body have to be dropped in order to strike the ground with a kinetic energy of 96 joules.

5 58. Starting from rest a 4.0 kg body slides down a 30° incline a distance of 2.0 m. If a constant force of friction of 4.0 newtons acts against the motion, calculate the speed of the body at the end of the 2.0 m.

FOR ROUGH WORK
(No marks given for work in this space)

Values

7 59. Two positive electric charges of 1.0 × 10^{-6} coulomb each are located 5.0 m apart. Find the magnitude of the total electric field they cause at a point 3.0 m from one of them and 4.0 m from the other.

(OVER)

Values

6 60. Determine the resistance of a heating element which produces 600 cal of heat every minute when a potential difference of 120 volts is maintained between its ends.

FOR ROUGH WORK
(No marks given for work in this space)

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